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A study of thermoelectric β-Zn_4Sb_3 under thermal cycling and large temperature gradients

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β-Zn_4Sb_3 is among the highest performance and lowest cost thermoelectric (TE) materials in the medium to high temperature region [1]. However, the usage of this material in practice for TE power generation is still hindered. In this study, the thermoelectric properties of β-Zn_4Sb_3 legs are investigated under thermal cycling at hot-side temperatures up to 718 K, and in a large temperature difference of 653 K, corresponding to the hot and cold side temperatures of 673 K/293 K. The results after thermal cycling reveal that a zT value of about 1.4 at 718 K is maintained after 30 cycles. However, under a temperature gradient of 653 K for 24 hours, the β-Zn_4Sb_3 leg gradually decomposes into zinc whiskers and ZnSb. This occurs in a temperature range lower than 563 K due to the nature of the phase transition [2]. This study provides insight into the stability of β-Zn_4Sb_3 under large temperature gradients.

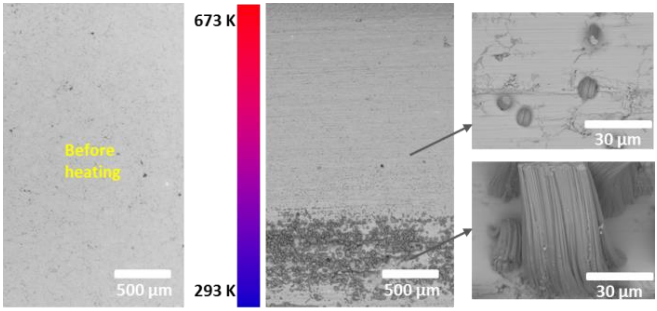

Figure 86: SEM micrographs of β-Zn_4Sb_3 sample before and after 24 hours under temperature gradient of 653 K.

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[2] J. Lin et al., “Unexpected high-temperature stability of β-Zn4Sb3 opens the door to enhanced thermoelectric performance” J. Am. Chem. Soc., vol. 136, 1497(2014).